Aeroacoustic Calculations of Wind Turbine Noise with the Actuator Line/ Navier-Stokes Technique - DTU Orbit (08/11/2017)

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Noise regulations in many countries are becoming extremely strict and wind turbine noise is thus becoming a barrier for further development of onshore wind turbines. Low noise wind turbine airfoil and blade design is an important technique for noise reduction. However, the ow situation of a wind turbine in wind farms is very complicated. In order to accurately model the noise generation and propagation from wind turbines in wind farms,it is urgent to develop a high-fidelity noise model to predict the noise features in complex situations. In the present study, we develop a flow-acoustic splitting technique where the wind turbine flow is calculated by using the in-house actuator line/LES/Navier-Stokes technique and the acoustics is obtained by solving the acoustic perturbation equations. In the flow solver, the wind turbine blades are modelled by rotating lines with body forces determined according to the local conditions and airfoil data. In the acoustic solver, the aeroacoustics is simulated by: (1) calculating the noise source using the improved engineering model (IBPM) based on the model developed by Brook, Pope and Marcolini (BPM); (2) introducing the noise source with an expected range of frequencies along the blade lines in the acoustic solver; (3) solving the acoustic perturbation equations with the introduced source and the source captured in the flow. The model can be used to study the prediction and propagation of low-frequency noise in complex situations. Noise generated by a wind turbine with and without yaw under wind shear and inflow turbulence will be presented in the paper.

General information

State: Published
Organisations: Department of Wind Energy, Fluid Mechanics
Authors: Debertshäuser, H. (Intern), Shen, W. Z. (Intern), Zhu, W. J. (Intern)
Number of pages: 13
Publication date: 2016

Host publication information

Title of host publication: Proceedings of the 34th Wind Energy Symposium
Publisher: American Institute of Aeronautics & Astronautics
Article number: AIAA 2016-0750
Main Research Area: Technical/natural sciences
Conference: 34th Wind Energy Symposium, San Diego, CA, United States, 04/01/2016 - 04/01/2016
DOIs:
10.2514/6.2016-0750
Publication: Research - peer-review › Article in proceedings – Annual report year: 2016